

throughout California. In effect, the snowpack serves as the region's largest natural water reservoir. Global warming will reduce the capacity of this reservoir, presenting challenges to water management strategies that depend on it.

Without new policies in place that accommodate changes to the state's natural hydrology, pressure may build to increase water diversions and exports in the Sierra Nevada and foothills, further affecting the region's habitats. Increased water conservation, watershed planning, mountain meadow restoration, and more comprehensive flood policies can help us better manage this changing hydrology and ensure cool, clean water is available for wildlife.

**Coldwater fish thrive in the rivers originating in the Sierra Nevada. Historically, one to three million Chinook salmon (pictured here) spawned each year in the western Sierra, with some ascending up to 6,000 feet in elevation.<sup>56</sup> Today, recreational fishing in the Sierra Nevada is valued at approximately \$200 million annually.<sup>57</sup>**



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## Klamath River Basin: UNCERTAIN AND OVERSTRETCHED WATER SUPPLIES

The Klamath River Basin has been blessed with ample water supplies and prime habitat for salmon, steelhead, trout, and countless waterfowl. With runoff from nearby mountains—including the Coastal Ranges, the Trinity Alps, and the Marble, Salmon, and Russian Mountains—combined with up to 100 inches of annual rainfall in the lower part of the basin, the Klamath has earned a reputation for phenomenal aquatic habitats.<sup>61</sup> Historically sustaining the third largest salmon and steelhead run on the West Coast, the basin and adjacent coast of northern California still support one-third of California's Chinook, most of California's Coho salmon and steelhead, and all of California's coast cutthroat trout.<sup>62</sup>

Although 80 percent of the Klamath basin's wetlands have been drained to support agriculture, the region remains a major spring and fall stopover spot for Pacific Flyway waterfowl, including tens of thousands of white-fronted, snow, Ross's, and Canada geese, tundra swans, northern pintails, mallards, American wigeon, and other ducks. The area also supports among the most prolific breeding populations of ducks, herons, egrets, terns, avocets, white-faced ibis,

geese, and grebes, as well as the largest population of wintering bald eagles in the lower 48 states.<sup>63</sup>

Yet, water in the Klamath region is in high demand, and fish and waterfowl often end up paying the price. The region now has chronic low water flows, higher water temperatures, and poor water quality. Dams and water diversions, mining operations, logging practices, livestock grazing, and agricultural channel and berm construction have reduced riparian vegetation and shade, helping to earn the Klamath River "impaired" status under the Clean Water Act because of high temperatures.<sup>64</sup> Fish in the region have been pushed to the brink: between the 1950s and 1990s, salmon and steelhead populations declined 80 percent.<sup>65</sup> Coho salmon, an indicator of overall watershed health, were listed as threatened under the federal Endangered Species Act in 1997.<sup>66</sup>

Low summer water flows on the Klamath River and its tributaries will be increasingly common because of global warming. With a 3.8 degrees Fahrenheit warming, snowpack in the Cascades is projected to decrease by 66 percent, greatly reducing the snowmelt feeding the basin in the summer.<sup>67</sup> As the air temperature



Roberta Pumphrey

**"I want people like me, who have enjoyed more than forty years of wild trout fishing in places like the backcountry of Sequoia and Kings Canyon, to be able to pass their love of the Sierra experience onto their grandchildren. But if we allow global warming to alter the natural systems upon which our beautiful trout depend—from stream-flow patterns and spawning habitat to the composition and stability of insect populations—I'm concerned that those opportunities may not exist for tomorrow's anglers."**

### PETE PUMPHREY

*Fishing Guide in Bishop, California and writer for California Fly Fisher Magazine*

increases, so too will summertime evaporation of water from the Klamath, further diminishing water supplies.<sup>68</sup>

Global warming will exacerbate trends of increasing water temperatures in the Klamath River basin, affecting the region's fish populations. Chronic temperatures above just 59 degrees Fahrenheit in the Klamath River are associated with reduced swimming ability, increased vulnerability to disease, and low growth rates.<sup>69</sup> High water temperatures also lower the amount of oxygen available for fish and can cause juvenile Coho salmon to leave prematurely for the Pacific when ocean conditions are unfavorable.<sup>70</sup>

Existing dams and diversions will prevent fish from escaping to cooler upstream habitats and continue to affect water temperatures, quality, strength, and timing. Even fish that do not migrate to the ocean, such as redband and rainbow trout and Klamath smallscale sucker, move widely and may be negatively affected by limitations on their movement.<sup>71</sup>

Furthermore, as rising air temperatures heighten agricultural



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and landscape water demands, the decreasing availability of freshwater could raise the cost of supplying water to Klamath Basin rivers.<sup>72</sup> Without proper management, less water means more competition for this scarce resource and a greater chance that fish and waterfowl will lose out. Anglers in a region once known for large coldwater fish may instead be limited to catching smaller and less healthy fish, while some areas may become entirely unsuitable for fishing.

**In 1908, President Theodore Roosevelt created the Lower Klamath National Wildlife Refuge, the nation's first refuge for waterfowl like this Gadwall duck.**

## THE KLAMATH KILL - HARBINGER OF THINGS TO COME?



Northcoast Environmental Center

**The vulnerability of local fish to changes in water flows was dramatically illustrated by the fish kills on the Klamath and Trinity Rivers in September 2002. Due to water diversions for irrigation during a severe drought, flows at several locations were between 11 and 64 percent of historic averages.<sup>73</sup> This made the year's somewhat large run of salmon more susceptible to disease**

**by increasing water temperatures, increasing crowding, hampering fish passage and upstream migration cues, and increasing the spread of disease. The result was the largest known adult salmon kill in the Klamath River, affecting primarily fall-run Chinook salmon, as well as Coho salmon, steelhead, and others. According to a report by the California Department of Fish and Game, 34,000 to 79,000 fish died before spawning.<sup>74</sup>**